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MAINE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 3.

SECOND SERIES.

THE BABCOCK MILK TEST ADAPTED TO TESTING CREAM.

J. M. BARTLETT.

During the past few years several simple and accurate methods for estimating fat in milk, adapted to the use of creameries and cheese factories, have been devised by different chemists. Most of these methods are very useful in testing milk and can be used for testing cream, but none of them seem to be especially adapted to the latter purpose and consequently are of no great value to creameries that collect cream only. The need of some method for determining the value of each patron's cream is now acknowledged by every one that has had much experience with creameries.

Even if the patrons of a creamery all use the cold deep setting process and are careful to keep the water at about 40° at all times, the cream from different animals or herds may vary several per cent.

Fifty samples of cream raised by this process, collected by creameries, were tested at the Conn. Exp't. Station and showed a variation of six per cent. of butter fat. One sample contained 23.8 per cent. another 17.78 per cent.

The temperature at which the milk is kept makes a very great difference in the quality of the cream. If the water in which the cans are submerged is allowed to become warm the cream will be much richer than when it is kept cold. The percentage of fat in cream from the same cows may be increased ten per cent. or more by keeping the water at 70° instead of 40°. Several samples collected by a creamery agent were tested. The lowest yield of fat was 12 per cent. and the highest 30 per cent.

The most of the samples gave from 17 per cent. to 22 per cent.

If this creamery had allowed equal amounts of butter for every inch of cream a great injustice would have been done to some of the patrons.

The writer has for the past few months devoted what limited time could be spared from other station work to studying methods with the idea of especially adopting some one for testing cream. As a result of this investigation the method devised by Dr. Babcock of the Wisconsin Experiment Station was selected, it being more simple and rapid than any that had appeared at the time of beginning this work.

Since that time the Beimling method has been brought out and by some is considered equally good, but the apparatus is a little more expensive. The Babcock method is fully explained in Bulletin No. 24 of Wisconsin Experiment Station, therefore it is only briefly described here. The milk is measured into a test bottle with a graduated neck, and about an equal amount of sulphuric acid is added, which dissolves all solids except the fat. The bottle is then at once whirled in a centrifugal machine to collect the fat on the surface of the liquid. Hot water is then added to raise the fat into the graduated part of the neck of the bottle, where the percentage can be read. The bottle used in the milk test as devised by Dr. Babcock is graduated to estimate no higher than 10 per cent. of fat, and as cream usually contains much more than that, it is evident this bottle cannot be used, if the same quantity (18 grams) is taken for the test.

To take a smaller quantity increases the liability to error and impairs the accuracy of the results. A pipette one third the size used for milk, made to deliver about six grams of cream, was first tried, but so much care was necessary to obtain good results the idea was abandoned. In reading a long column of fat, unless one is expert and very careful to keep the temperature constant, he is liable to make an error of 0.2 or 0.3 per cent., and when only six grams of cream are used the reading must be multiplied by three, which increases the error three-fold. Dr. Babcock recommends using three bottles, dividing the pipette full into three parts, putting one third into each bottle and adding the three readings. This method involves so much work that it would not be practical in testing a large number of samples. To overcome these difficulties the writer used a bottle like No. 2, graduated to read from 0.2 to 25 per cent. of fat, the bulb on the neck holding 10 per cent. With this bottle cream containing not more than 25 per cent. of fat can be as easily and accurately tested as milk, and as cream raised in deep cans submerged in cold water very seldom contains much over 20 per cent. these bottles are sufficiently large

to answer the purpose of our creameries. Very rich cream containing over 25 per cent. fat may be diluted one half with water, or a 9c. c. pipette can be used and the readings multiplied by 2., but can be more accurately tested with a bottle like No. 3 described later on.

These test bottles can be used just as well for milk, so another set is not necessary. Bottle No. 2 cannot however be used in the regular size centrifugal machine as it is about one and one-half inches longer than the bottles used for milk testing.

A bottle of the same style, graduated to read to 23 per cent. may be used in the regular size machine.

No. 3 represents a bottle designed for testing very rich cream without reducing the quantity used for the test. Such cream, carrying over 30 per cent. fat, is frequently obtained from the separator or from milk kept at a temperature of about 60° or 70°. This bottle as is shown by the diagram is made in two pieces and is graduated to read to 35 per cent. It has some advantages over the other kinds for the reason the base is the portion most liable to breakage, and is separate from the more expensive graduated neck. One could have a large number of the bases and not require more than a dozen of the graduated necks to operate them successfully.

TESTING CREAM.

Sampling.

The first and one of the most important parts of the process is sampling the cream, for it is plain that unless this is properly done and the portion taken for the test correctly represents the whole, the results that follow must necessarily be incorrect. The lot of cream to be sampled should be put in a can or some vessel sufficiently large to hold it all, and another vessel of equal size being at hand, it should be turned alternately from one to the other four or five times to thoroughly mix and make it homogeneous. The sample must be immediately taken after the mixing is done, and put in a vessel properly labeled and suitable for the purpose. A half pint fruit jar answers the purpose well, which must be filled full to avoid churning.

How often should tests be made?

In order to be *very* accurate and ascertain exactly the amount of fat in each patron's cream, it would be necessary to take a sample from every lot collected—a definite amount, 1 oz. for every inch or quart furnished, should be taken. That is, if a patron furnishes

six quarts to-day six ounces should be taken for the sample, and if he furnishes ten quarts to-morrow ten ounces should be taken for the sample.

These samples can be kept sweet in an ice chest for a week and then be thoroughly mixed together and tested. The result will accurately represent the per cent. of fat in the cream for that week. Many creameries cannot afford the time to collect samples and make tests so often, and it is not necessary if the patrons will exercise a little care to keep the water surrounding the milk cans always at the same temperature as nearly as possible. A test made once in two or three weeks will then suffice and give a sufficiently accurate basis on which to value the cream. It would be advisable to take samples for three successive days and mix them for the test. This would give a more accurate result than if only one sample was taken.

Performing the test.

With sweet cream that is not frothing, the method does not vary from that described for milk when the test bottle like No. 2 is used. A copy of these directions is furnished with each machine so a description is not necessary here. In adding hot water to the test bottles the first time, I find it most convenient to fill them to about the 20 per cent. mark, then one can easily see how much to add the second time to bring the fat where it can be measured. The measuring pipette is the same as that used for milk except it has two marks on it. The lower one (17.6) is to be used in measuring milk, the upper one (18) for measuring cream. From this latter mark the pipette delivers 18 grams of cream, raised in cans submerged in cold water, with sufficient accuracy for all practical purposes. For testing richer cream, a correction must be made because of the weight of cream delivered by the pipette decreases as the per cent. of fat increases.

For a scale reading of 25 per cent. add 0.15 per cent.; for a scale reading of 30 per cent. add 0.3 per cent. Readings between or above these may be corrected proportionately.

If the cream to be tested has become sour and curdled so it can not be handled with a pipette, it can be rendered mobile by placing the jar containing it in water and heating the whole to about 125° F., then passing the cream through fine wire gauze, (a flour sieve will do very well for the purpose.) Any lumps that remain on the sieve may be rubbed through with the finger. After passing the warm cream through the sieve two or three times, it will after

cooling, be in condition to measure with the pipette. On account of the small particles of curd, sour cream adheres much more to the walls of the pipette than sweet cream, therefore a little water (4 or 5 c.c.) must be used to rinse the pipette into the test bottle. Unless this is done the results will be from 0.2 to 0.4 per cent. too low. About 20c. c. of acid should be used when the pipette is rinsed. When the cream is frothing badly and contains a large amount of air or gas bubbles, as is sometimes the case with cream that is very sour or taken from a separator, it cannot be accurately measured but must be weighed. The writer has made several tests when the error in measuring frothy cream was over 5 per cent. of the total fat.

The only accurate method to pursue in such cases is to weigh the cream, and this can be very easily done by any one who has skill enough to make the test. A good little scale for the purpose is made by the Springer Tortion Balance Co., 92 Reade St., N. Y. Their No. 302 Handy Scale, costing about \$4.00 with a weight that when put on the 8 oz. notch weighs 18 grams, is sufficiently accurate and very convenient. We would advise creameries using this test to get a scale for the purpose mentioned, for there will be instances when it will save much time and trouble. The method of using the scale is very simple. The empty test bottle is set on the pan and counterpoised by means of the ounce weight and screw at the end of the scale arm; then the 18 gram weight is put on the 8 oz. notch, the pipette filled with cream a little above the mark and emptied into the test bottle until it is nearly all in, when the finger is pressed on the top of the pipette sufficiently to allow the cream only to drop slowly till the scale turns. One can weigh with a little practice about as rapidly as he can measure. This scale will also be very convenient in testing butter and cheese, as with solids it is necessary to weigh out the portions for the test.

In using the test bottle No. 3 the method is slightly modified in the latter part of the process. The base portion, into which has been measured the cream and acid, is put in the centrifugal machine and whirled for five minutes the same as with the ordinary bottles. As much hot water is then added as the base will hold without danger of spilling, and whirled for two or three minutes more, to collect the fat on the top of the water. The base is then taken and connected with the graduated neck by a piece of rubber tubing. The whole is then put in a tank or pail of water, heated to about 110 to 120 F. and the fat raised into the neck by

turning gently down the side hot dilute acid in sufficient quantity to fill the bottle to about the 34 mark. The fat usually rises and forms a compact column in two or three minutes so that by the time the 10th or 12th bottle is put into the warm water, the first can be read, giving directly the per cent. of fat.

The dilute acid consists of one part by volume of strong acid to one part of water. In mixing, the water must always be put in the vessel first and the acid turned into it. If used immediately it will need no extra heating, as sufficient heat is developed in the mixing. We have only had opportunity to make 12 or 15 tests with this bottle, but they seem to indicate that it is accurate as can be seen by the table below.

One cannot work quite as rapidly as with bottle No. 3 therefore we would advise its use only on very rich cream containing over 25 per cent. of fat.

This form of bottle (No. 3.) can be used in the regular size machine.

WHERE TO OBTAIN THE APPARATUS.

Arrangements have been made with Cornish, Curtis & Greene, Fort Atkinson, Wis., manufacturers of the milk test apparatus, to furnish the modified apparatus to parties who may desire it at about the same price as the ordinary form.

Parties ordering the cream tester, must be particular to mention what they want or otherwise they may receive the wrong machine. Any of the pieces of glass-ware can be obtained of Emil Greiner, N. Y., and should be ordered by number, then no mistake can be made.

Cream Test bottle No. 1 is for use in the regular size milk testing machine and reads to 23 per cent.

Cream Test bottle No. 2 is for use in the machine especially made for the purpose and reads to 25 per cent.

Cream Test bottle No. 3, is for testing rich cream, can be used in either machine and reads to 35 per cent.

Sulphuric acid can be obtained of wholesale druggists, or dealers in chemicals. The Cochrane Chemical Co., Boston, Mass., sells commercial acid, specific gravity, 1.835, in carboy lots at very reasonable prices. Acid of this strength should be slightly diluted by adding about twenty parts of acid to one part of water by volume.

	Gravimetric Method.	Test Bottle with Bulb Neck.	Test Bottle with Separable Neck.
Cream No. 1.....	18.4	18.4	18.45
" "		18.35	18.40
" "			18.35
" "			18.40
" No. 2.....	14.3	14.1	14.0
" "		14.2	14.3
" "	"	14.1	
" "	"	14.3	
" No. 3.....	19.6	19.3	19.3
" "	19.7	19.3	19.5
" "	"	19.2	
" "	"	19.7	
" "	"	19.6	
" "	"	19.8	
" No. 4.....	18.62	18.4	
" No. 5.....	18.6	18.5	
" No. 6.....	20.4	20.1	20.0
" No. 7.	19.75	19.6	19.6
" "	"	19.6	19.8
" "	"	19.8	19.8
" "	"	19.9	19.9
" "	"	19.7	19.7

NOTE.—The object of this bulletin is to call attention to an accurate and rapid method of determining the percentage of fat in milk and cream. The apparatus as originally described by Dr. Babcock has been modified by Mr. Bartlett to meet the needs of creamery work in Maine and the new forms of testing flasks that have been devised are favorably regarded by Dr. Babcock. The Experiment Station does not assume that the managers of creameries are ready to value their patrons cream on the basis of the actual percentages of fat, neither does it propose at this time to urge such a course, for that is a purely business matter, but it seems very desirable that in case any creamery management should conclude to apply the only just standard of valuation, some practical method for doing this should be at hand. This bulletin presents such a method.

Should any creamery manager or private dairyman wish to purchase and put into operation the Babcock apparatus, the Experiment station will be glad to render all the assistance possible, either through suggestions about the purchase of, or instruction in the use of, the apparatus. Prompt attention will be given to all inquiries in regard to the matter.

W. H. JORDAN.

DIRECTOR.

ORONO, ME.,
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